

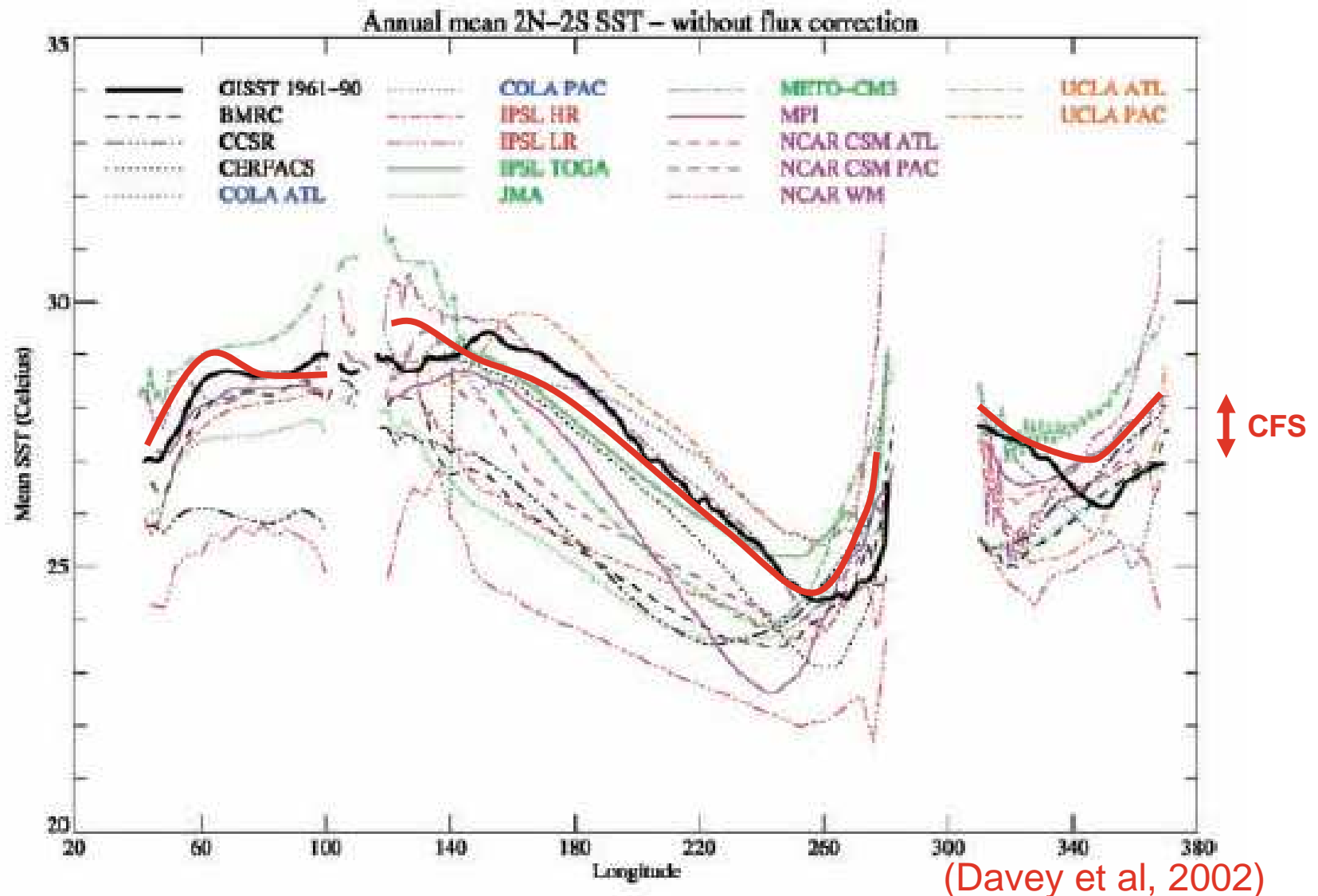
West African Rainfall and seasonal tropical Atlantic circulation in CFS

James Carton¹, Ching-Yee Chang, Semyon Grodsky, and Sumant Nigam (UMD), **Jiande Wang** and **Wanqui Wang (NCEP)**
(¹carton@atmos.umd.edu)

- Most CGCM efforts have concentrated their attention on the Pacific. But, the Atlantic has interesting and important climate variability.
- Because of the dominance of seasonal variability in the Atlantic, errors in our representation of the seasonal cycle will project onto seasonal forecasts, e.g. Nordeste Brazil.

Thanks: S. Saha (NCEP)

How CFS mean state looks in comparison with other CGCMs: SST averaged 2S-2N



NCEP/EMC's new Climate Forecast System

AGCM: T62L64 NCEP Global Forecast System model (GFS03)

- Boundary layer vertical diffusion

- Cumulus convection (simplified Arakawa-Schubert, Tiedtke shallow convection)

- Gravity wave drag

- Prognostic cloud/ice scheme

OGCM: GFDL MOM3 $1^\circ \times 1/3^\circ \times 40L$ in tropics

- KPP vertical mixing

- Gent and McWilliams horizontal mixing of tracers

- Smagorinsky nonlinear horizontal mixing of momentum

Coupling

- AGCM and OGCM exchange quantities once a day.

- IC: Global Ocean Data Assimilation System (GODAS) SST

Runs

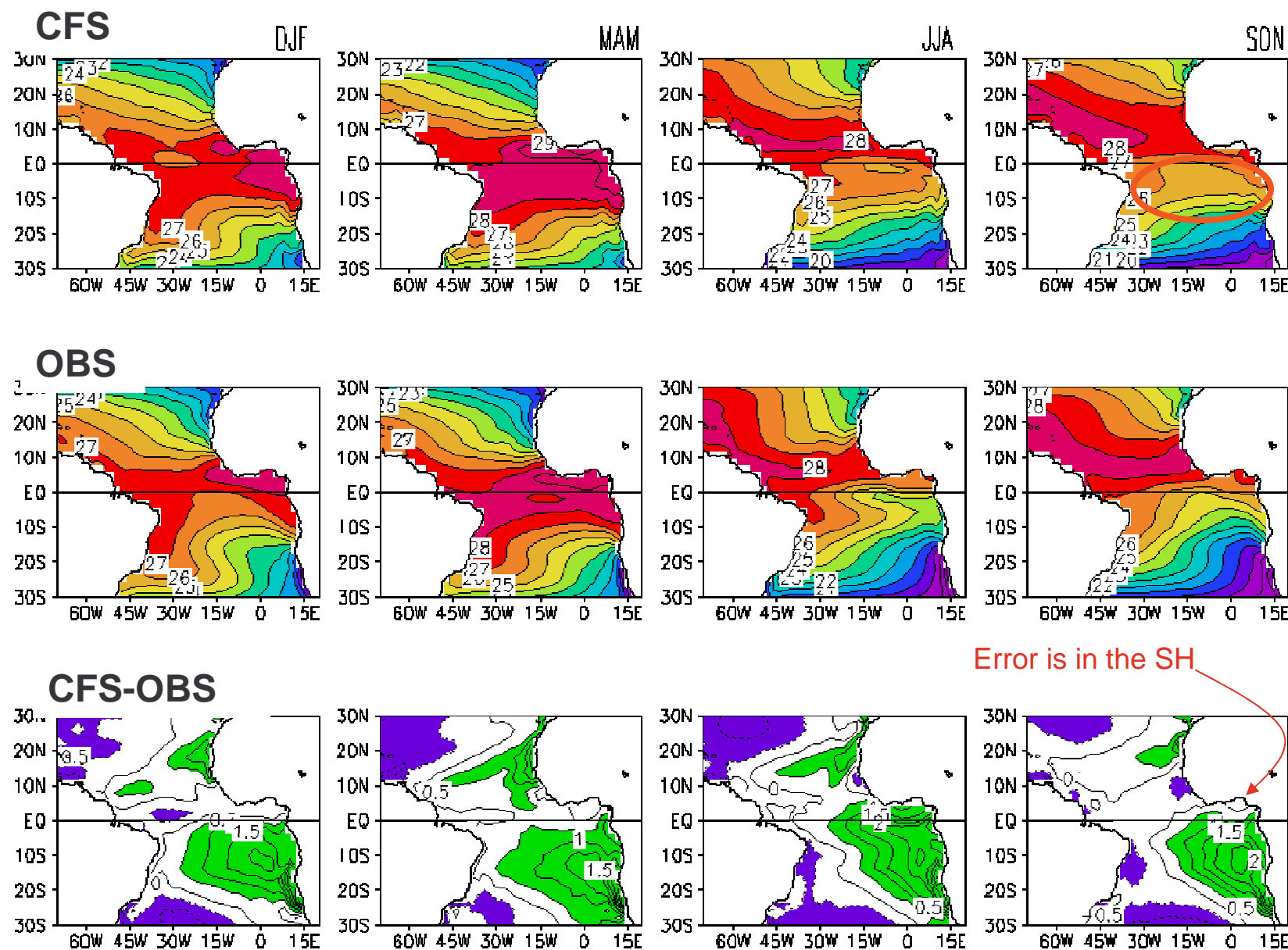
- 4 33-year coupled simulations

- 1 AMIP simulation

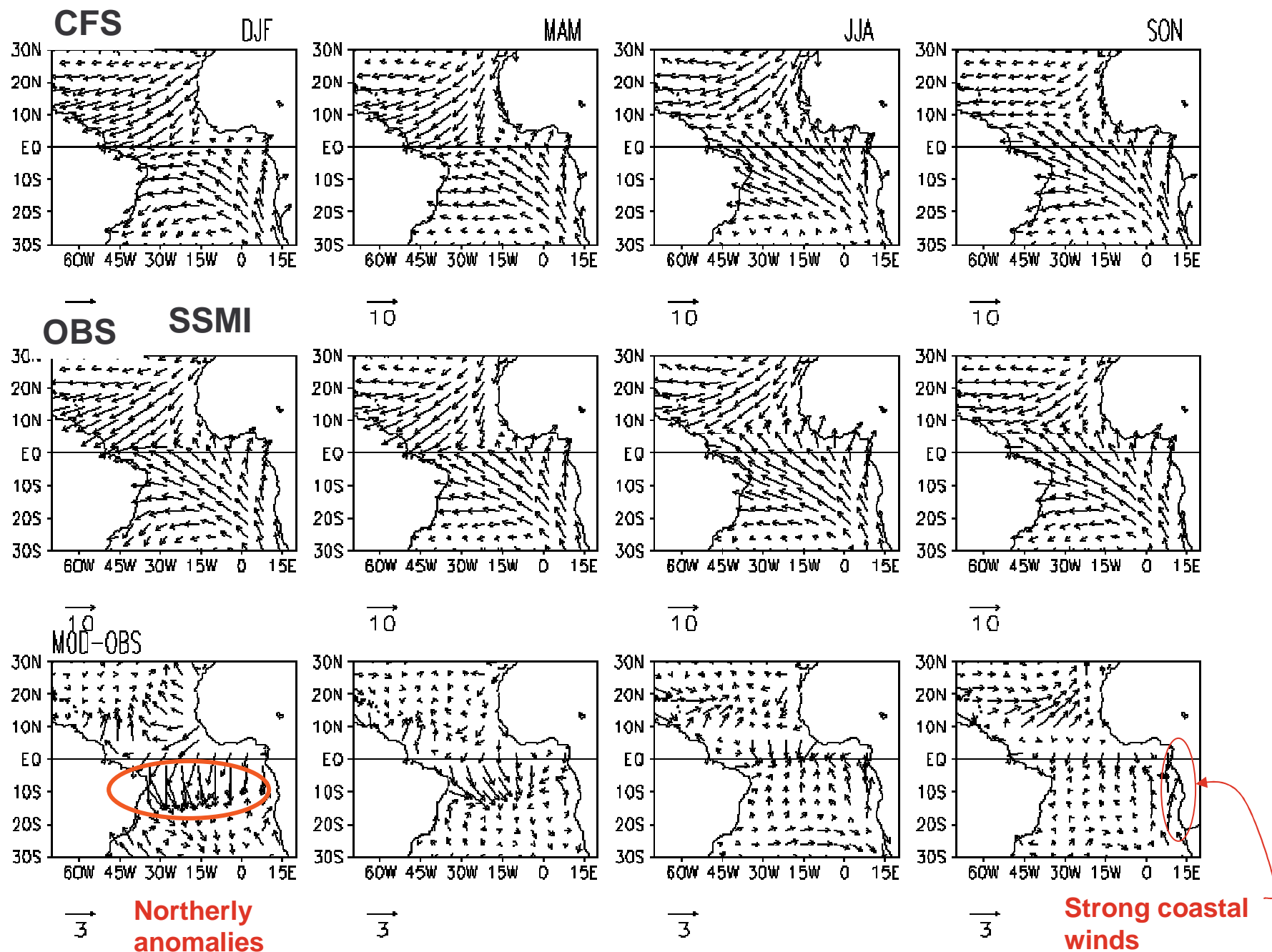
- Hindcasting: Nine month forecasts 1981-present with IC from each month (15 ensemble members for each month)

Surface variables

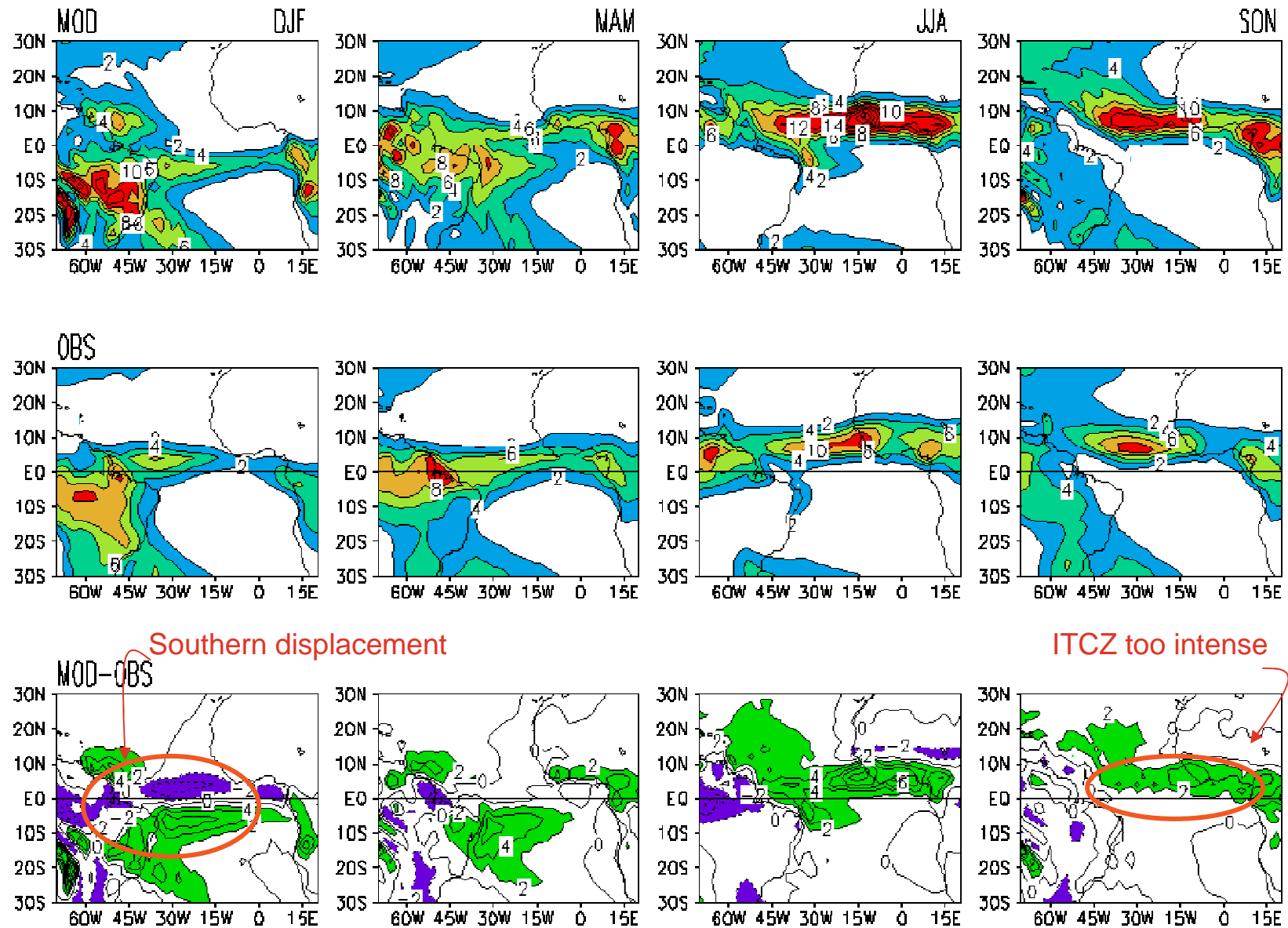
Seasonal SST



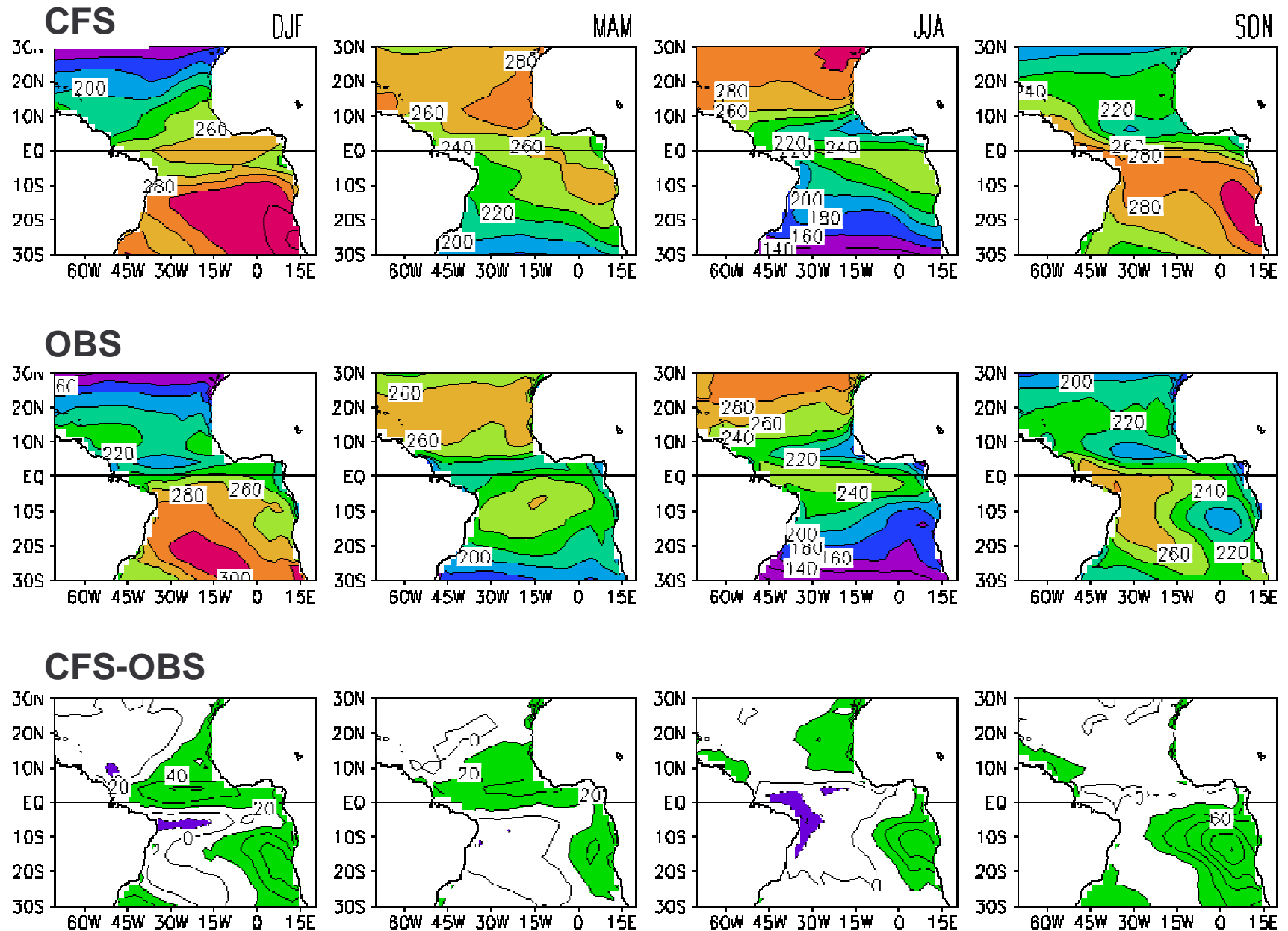
Seasonal winds



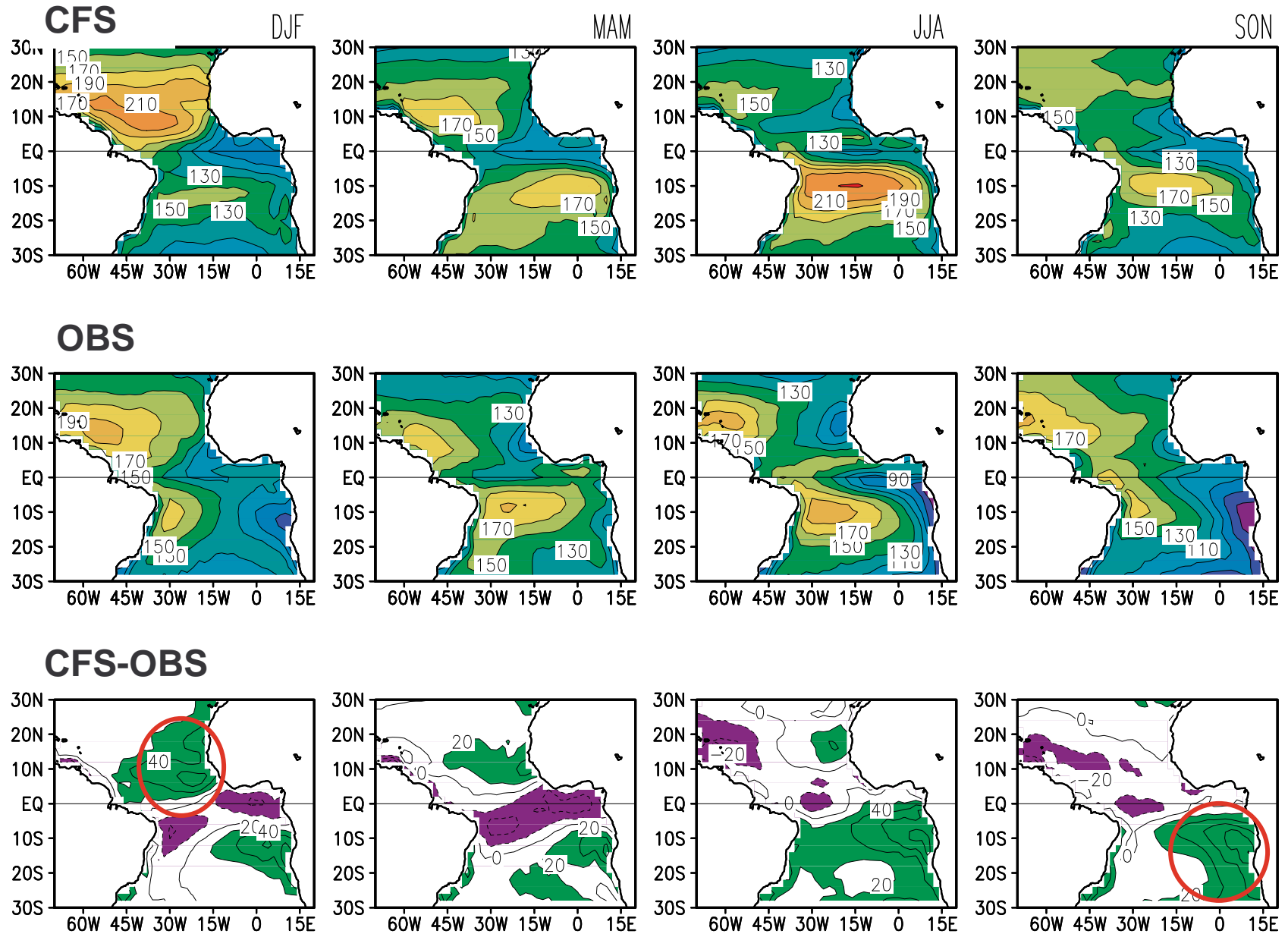
Seasonal rainfall



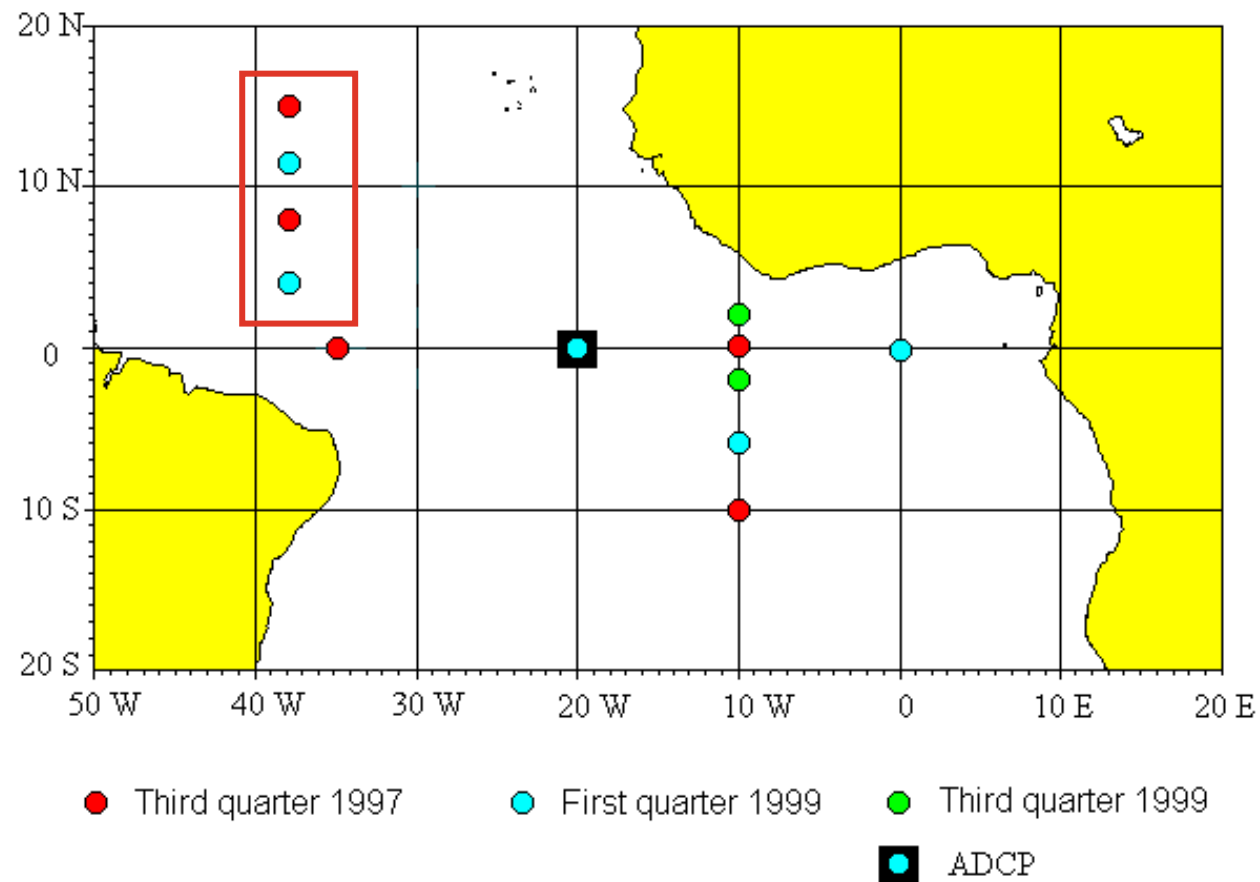
Seasonal net shortwave



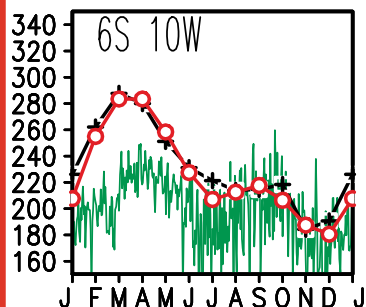
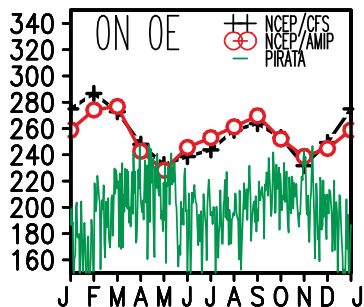
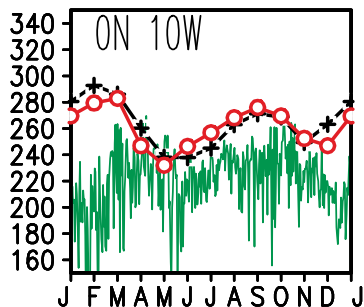
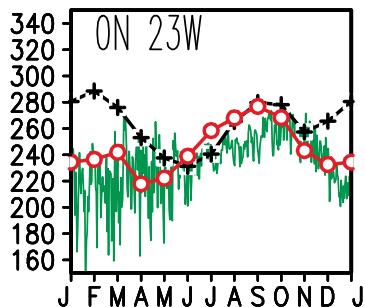
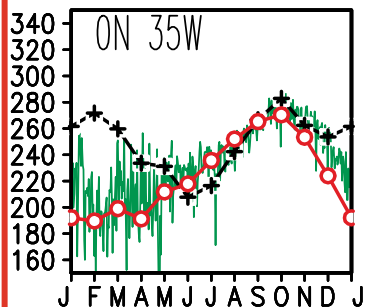
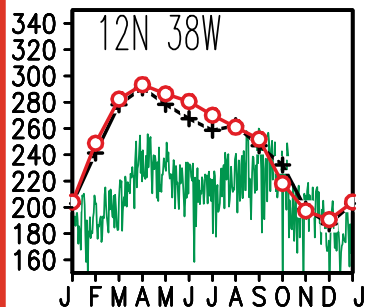
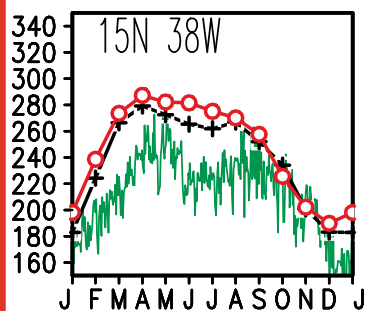
Seasonal latent heat



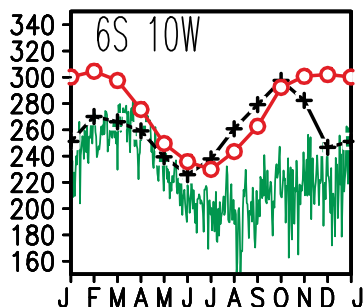
PIRATA moorings



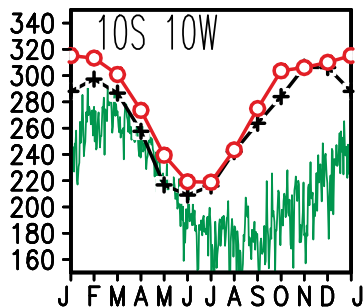
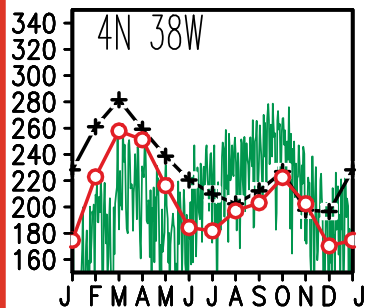
Seasonal short wave



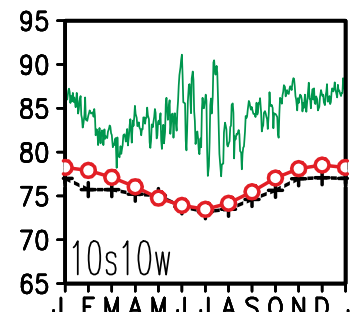
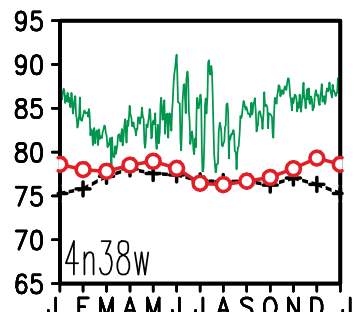
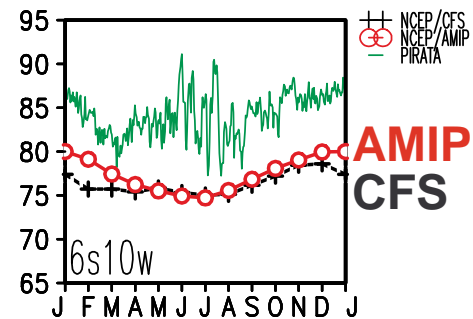
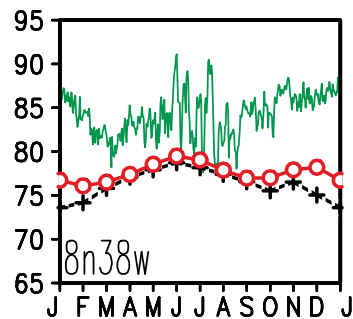
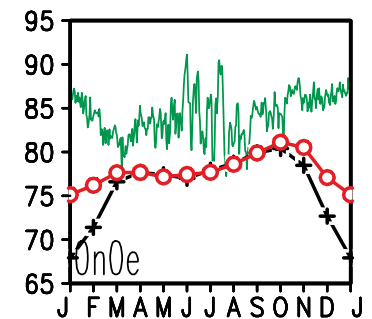
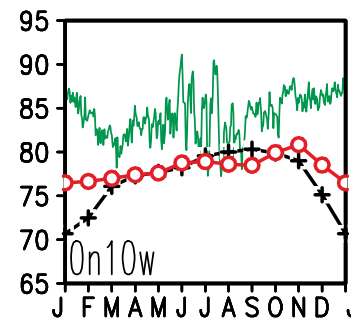
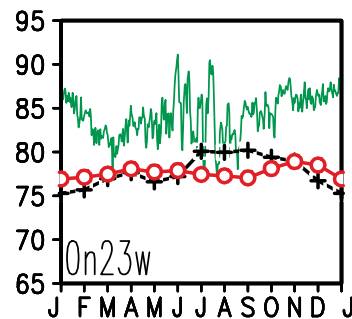
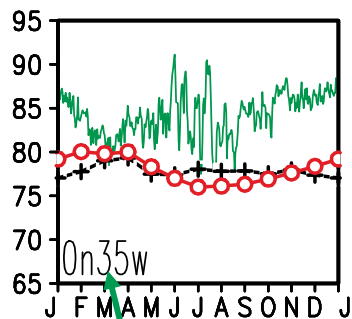
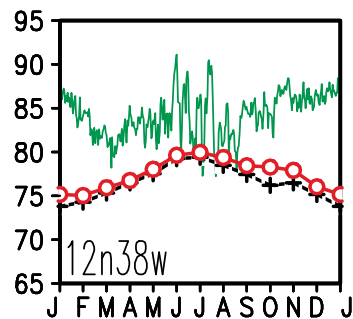
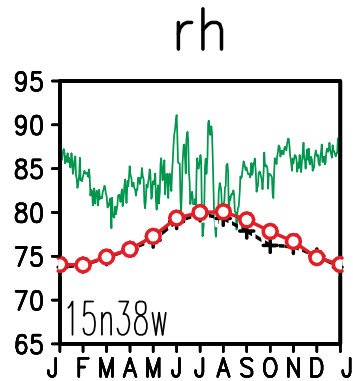
OBS



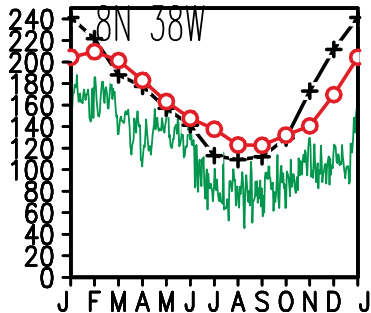
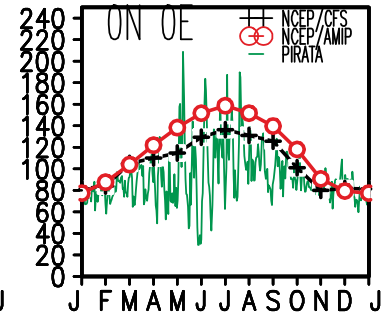
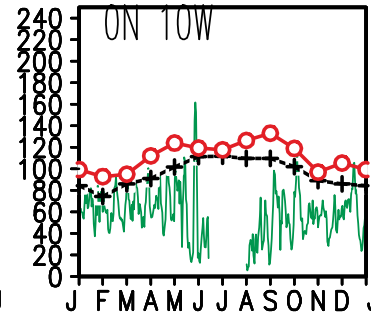
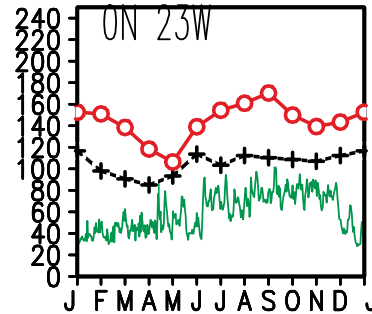
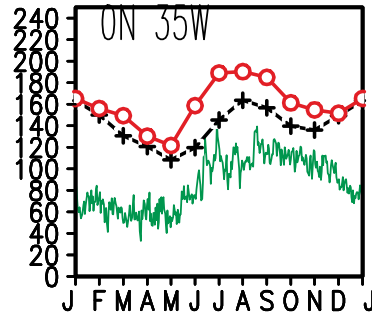
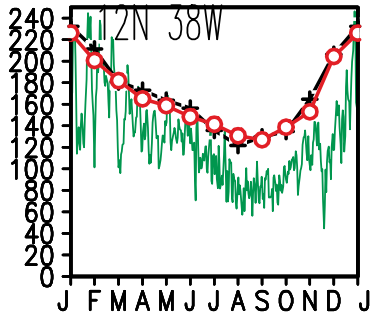
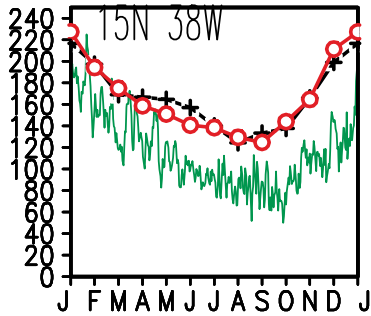
AMIP
CFS



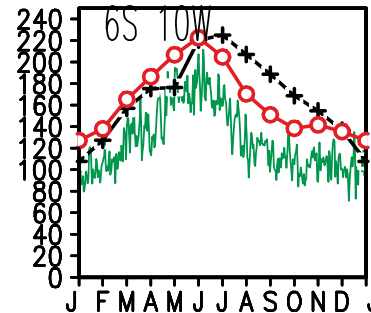
Seasonal relative humidity



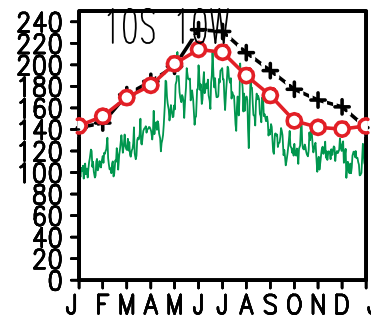
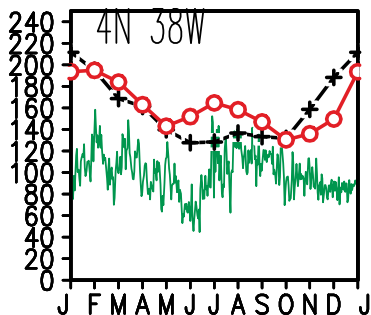
Seasonal latent heat



OBS



AMIP
CFS



Precipitation errors CFS vs AMIP

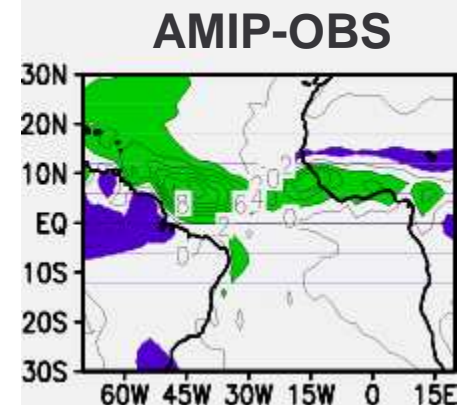
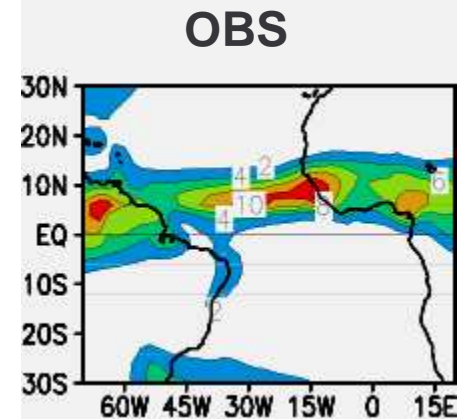
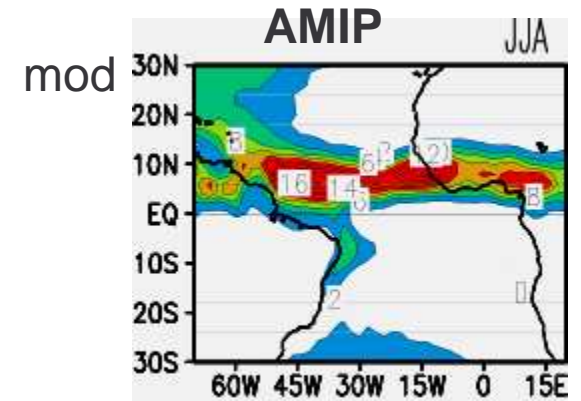
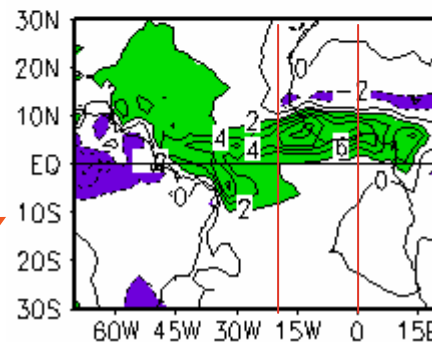
ITCZ error similarities:

- Intensification
- Southward displacement

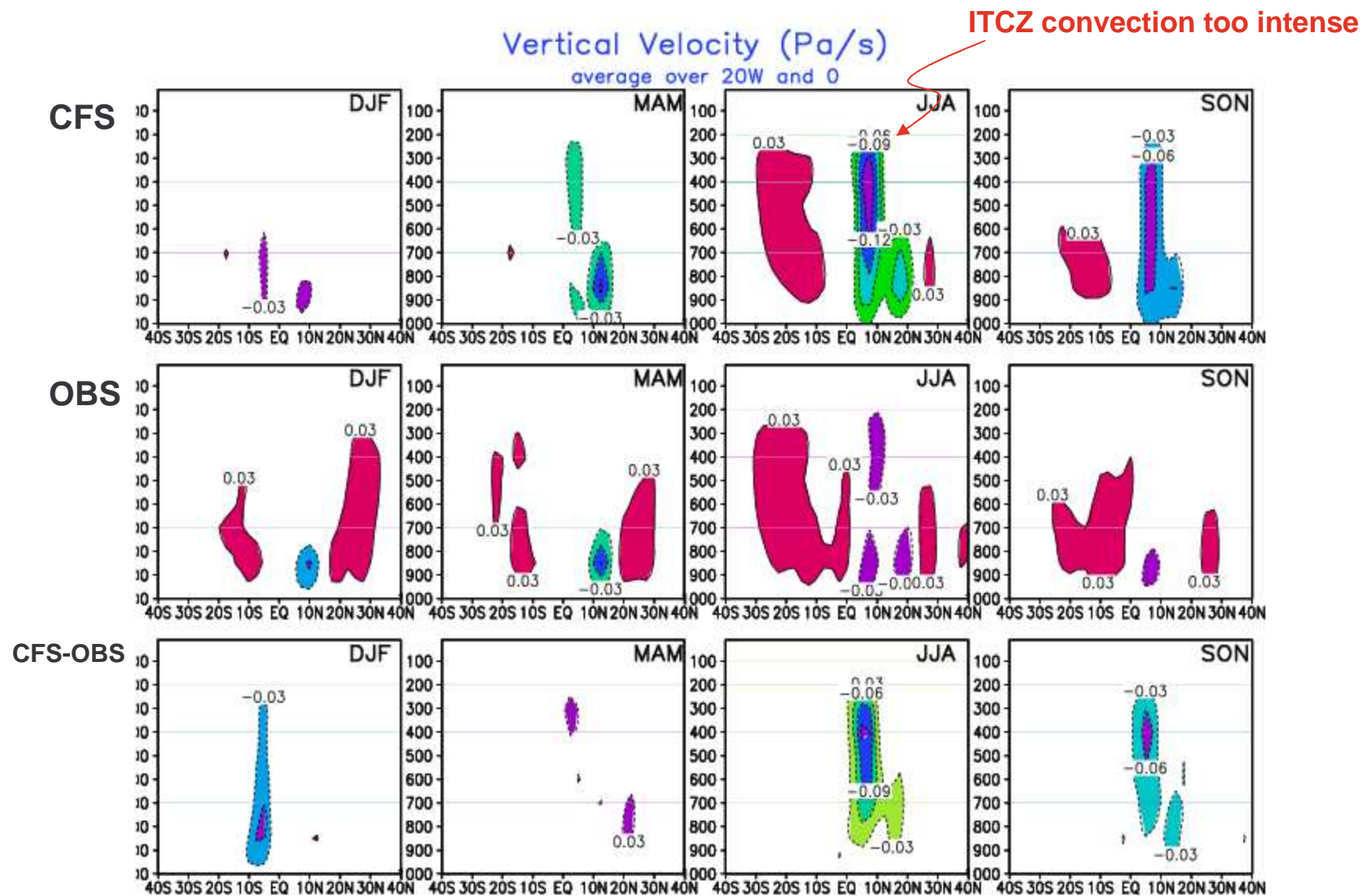
Next: w vs lat

CFS-OBS

What we
saw before



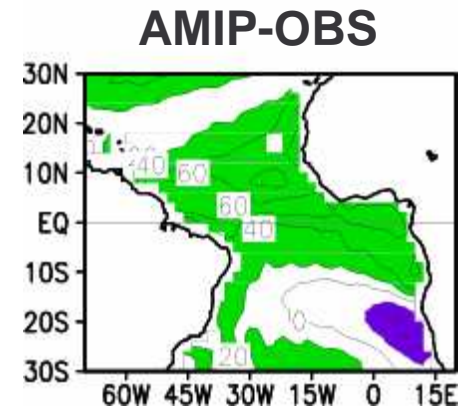
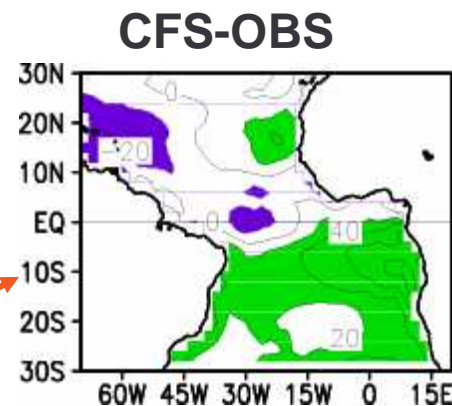
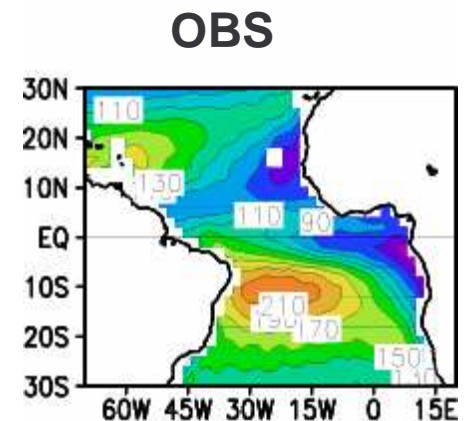
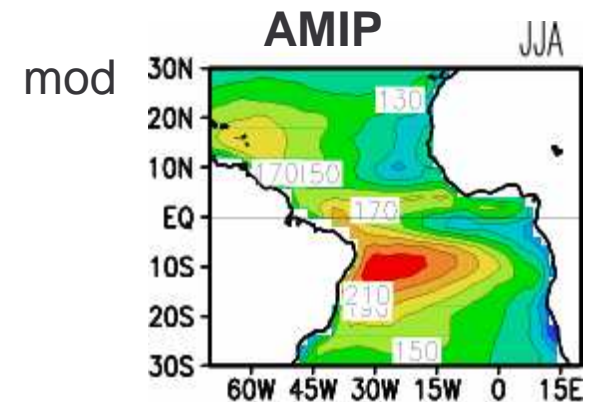
Vertical velocity with latitude (20W-0W)



Latent heat flux errors CFS vs AMIP

ITCZ error similarities:

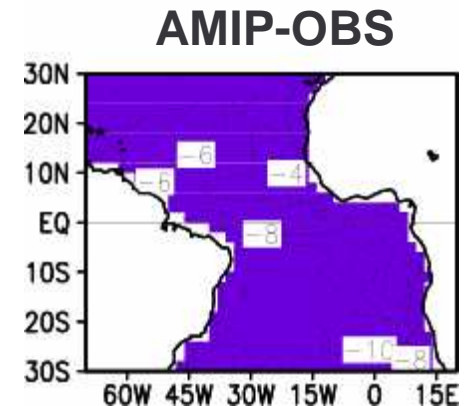
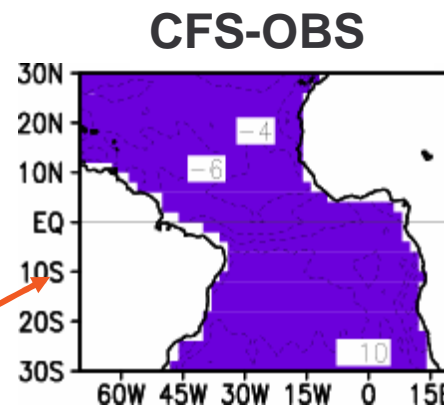
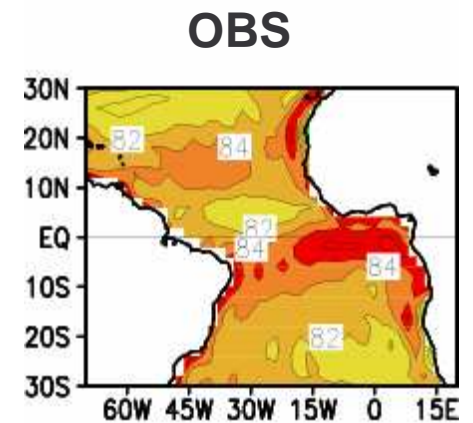
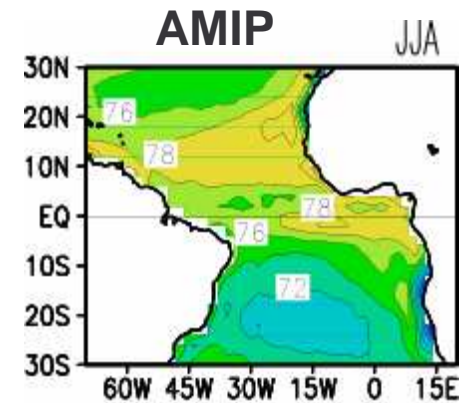
- Intensification
- Southward displacement



What we
saw before



Relative humidity errors CFS vs AMIP

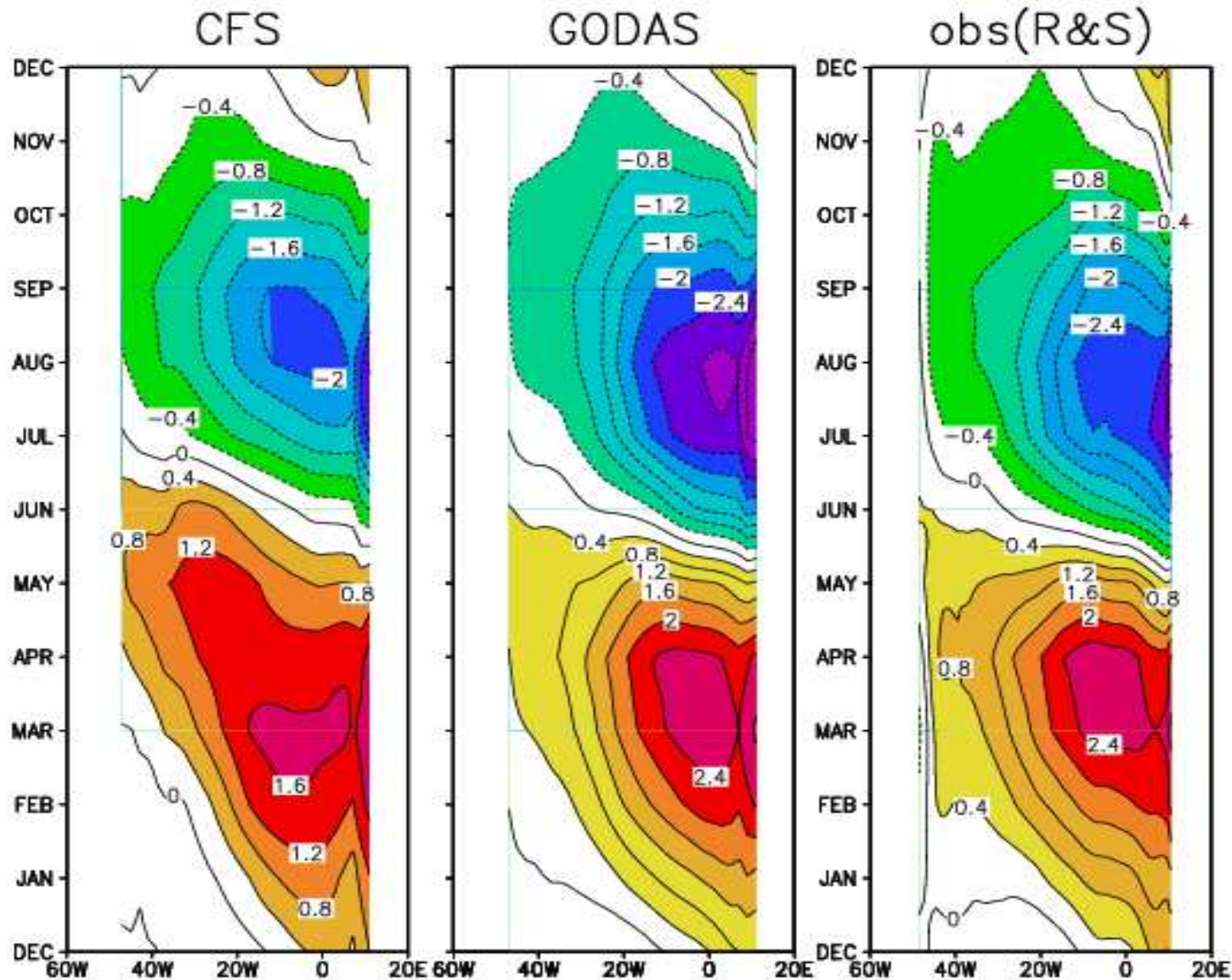


What we
saw before



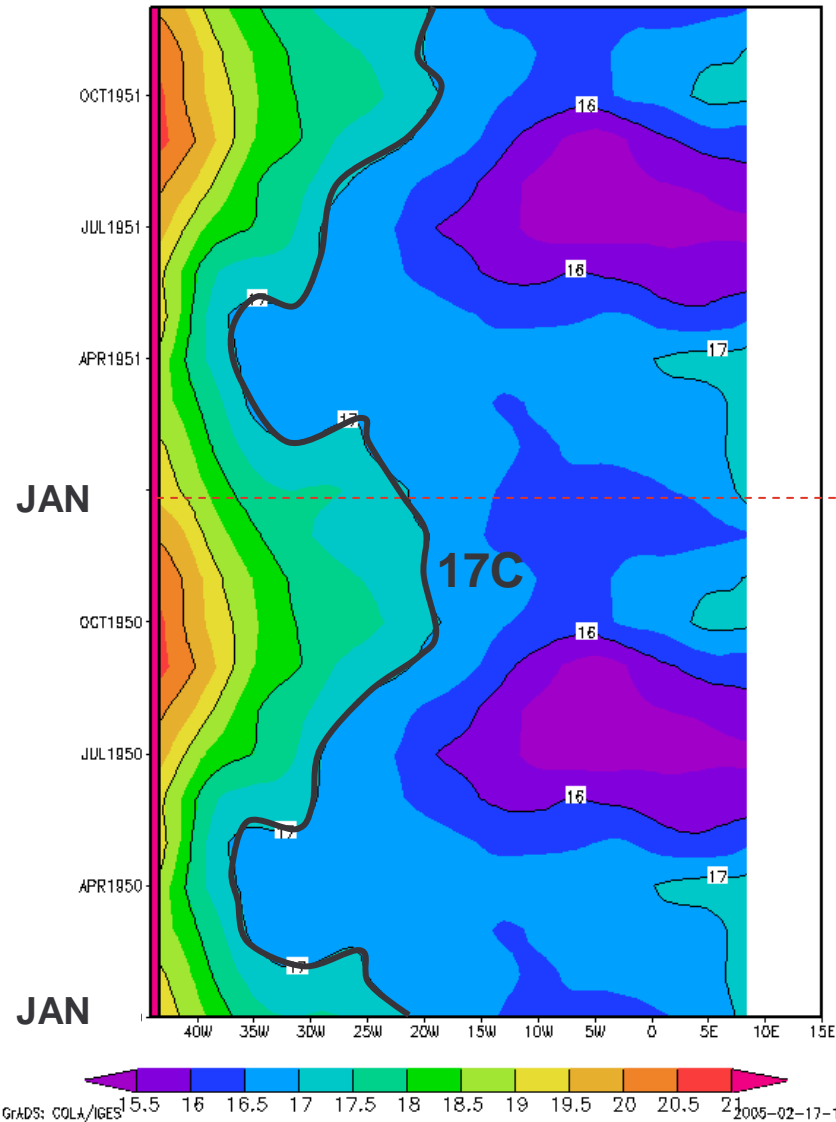
Ocean

Seasonal equatorial SST

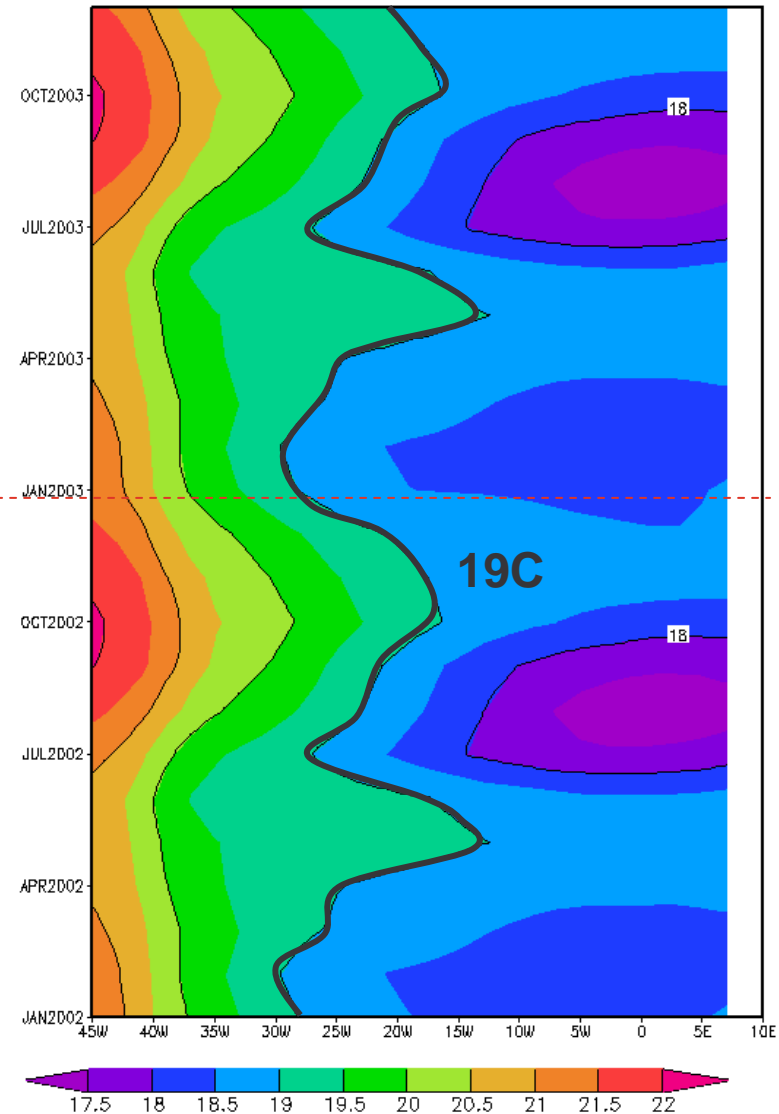


Effect of misplaced ITCZ?: enhanced semiannual cycle in HC

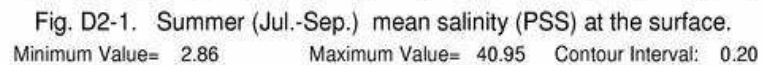
OBS TAVE(0/300m) ON



CFS TAVE(0/300m) ON

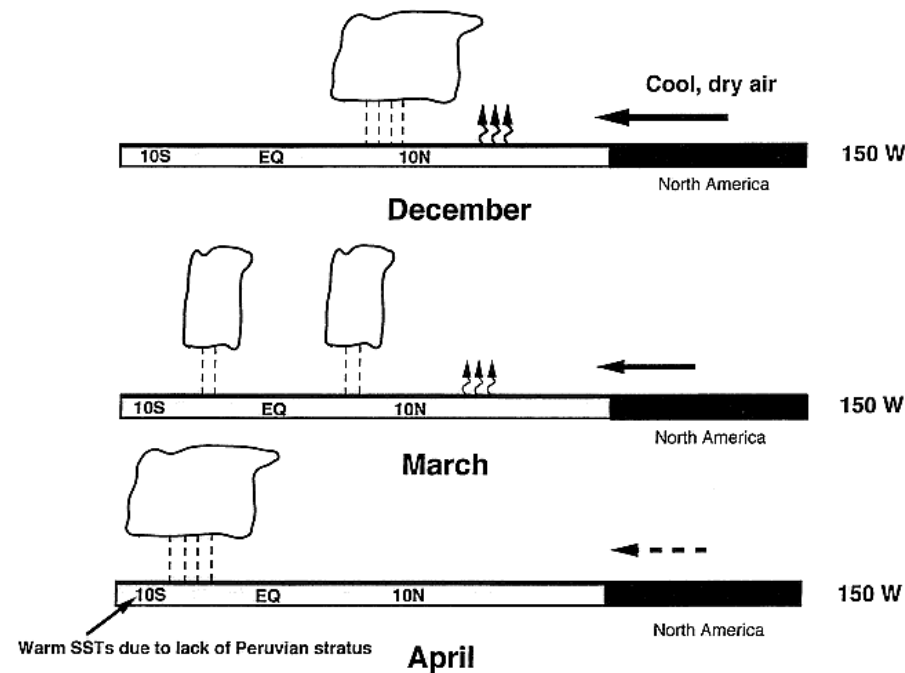


Jul-Sep Surface Salinity



Cause of Southern Hemisphere ITCZ

Conceptual model of *Yu and Mechoso (1999)* for the ITCZ errors in the UCLA model, eastern Pacific

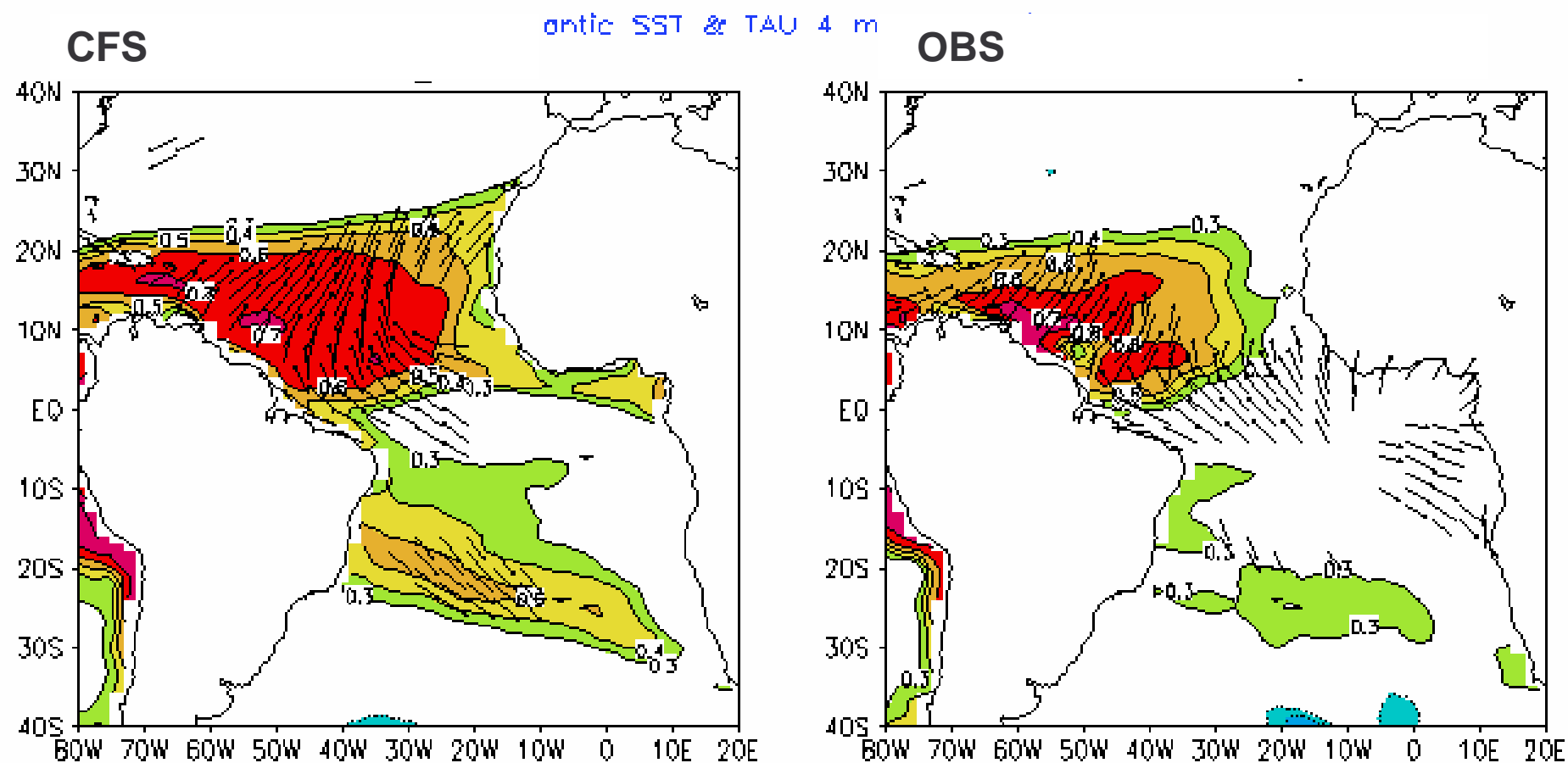


Can this explain what's going on in the western tropical Atlantic in CFS?

Interannual variability

Remote influence

Seasonal correlation of $(\text{SST, winds})_{\text{AMJ}}$ and $\text{NINO3}_{\text{DJF}}$



Issues

AGCM

- **Excess SW heat gain implying too little cloudiness in the east.**
 - Explains: SST error – upwelling is actually stronger than observed
 - Puzzles:
 - Why is the SST error primarily in the south?
 - Why is there so little low level cloud cover in CFS and AMIP?
- **Excess latent heat loss**
 - Explains: high salinities, High precip in ITCZ.
 - Puzzle: Why is RH < 80% over the ocean in both CFS and AMIP?

OGCM

- **Excess sea surface salinity**
 - missing river discharge
 - Explains: may explain why the thermocline is too deep as the result of too much tropical water formation.

CGCM

- **Boreal winter ITCZ southward displacement in the west**
 - Explains: Semiannual thermocline slope variations

Seasonal stratocumulus experiment

- UCLA CGCM: perpetual winter and summer experiments with prescribed clouds does cool the SST in the southeast. Will seasonal specification of clouds address bias in meridional winds and ITCZ convection?

Yu and Mechoso
(1999)

